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Model answers P2 set 2

**Q-1 A) Define .**

1. Enantiomers: Enantiomers are stereoisomers that are mirror images of each other.
2. Racemic mixtures: A racemic mixture is one that has equal amounts enantiomers. Racemic mixtures are optically inactive.
3. Titration error- the difference occurring between the end point and the equivalence point.
4. Standardization.-the process of determining exact concentration of a secondary standard solution by titrating it against primary standard solution.
5. Occlusion- type of co precipitation in which an impurity is trapped within a pocket formed with the process during rapid crystal growth.

**6.Partition coefficient.**-The ratio of the concentration of the solute in the two phases at equilibrium at a given temperature is called partition coefficient

**7. Distillation.**-Distillation is a physical process of separating the components of a liquid mixture by selective evaporation and condensation.

**8. Monochromatic light** -A beam in which all the rays have the same wavelength is known as monochromatic light.

**Fill in the blanks.**

9) The compounds  $\text{CH}_3\text{CH}_2\text{-O-CH}_2\text{CH}_3$  &  $\text{CH}_3\text{-O-CH}_2\text{CH}_2\text{CH}_3$  are \_\_\_\_\_Of each other.

**Metamers**

10) Alkene shows \_\_\_\_\_ isomerism due to restricted rotation around double bond.

**Geometrical**

11). ----- is a process by which a coagulated colloid reverts back to its original colloidal state.

**Peptization**

12) Photocell / Photomultiplier detector used as stationary phase in paper

**True or false.**

13) Geometrical isomerism occurs in monosubstituted cycloalkanes. -- True

14) D indicates dextrorotatory, L indicates laevorotatory. -- True

15. Polar solvent is used as stationary phase in paper chromatography.-True

**Give one word for**

16.Spraying reagent used for detection of amino acid.-Ninhydrin

17. Titration of oxidizing agent against reducing agent- Redox titration.

**18. Give formula for molar extinction coefficient.**

Molar extinction coefficient = absorptivity x molecular weight

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**Give two examples of:**

19. Primary standards in volumetric analysis.-Potassium hydrogen phthalate, succinic acid, potassium dichromate, KCl, salts of zinc.

20. Indicators used in complexometric titration.- Eriochrome BlackT, Solochrome Black T

**Q-2**

**A) What is isomerism? Explain the different types of isomerism with example. 8M**

Isomerism: The compounds have same molecular formula but differ from each other in physical or chemical properties are called isomers & the phenomenon is called isomerism.

Types of isomerism:

- 1) Constitutional isomerism.
- 2) Stereoisomerism.

Give types of each isomerism & example.

**B) Differentiate between Chain isomerism & Functional isomerism. 7M**

Chain isomerism	Functional isomerism
1. Isomers have same molecular formula but differ in the order in which the carbon atoms are bonded to each other.	1. Isomers have same molecular formula but different functional groups.
2. examples : n-butane & Isobutane, 2-Methylbutane & 2,2 Dimethylpropane Draw structures.	2.examples: Ethyl alcohol & Dimethylether Acetone & Propionaldehyde Draw structures.

OR

**C) What is meant by the terms erythro & threo? Explain with examples. 8M**

The molecule containing two chiral centres Erythro & Threo notations are used.

If two similar groups in projection formulae are on same side ,the isomers is called Erythro form & if they are on opposite side , then the isomer is called threo form.

Draw the structures of Erythro- Tartaric acid & Threo -Tartaric acid.

**D) What are the different types of projection formulae? Explain with examples. 7M**

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Types of projection formulae:

- 1) Fischer projection formula.
- 2) Newmann projection formula.
- 3) Sawhorse projection formula.

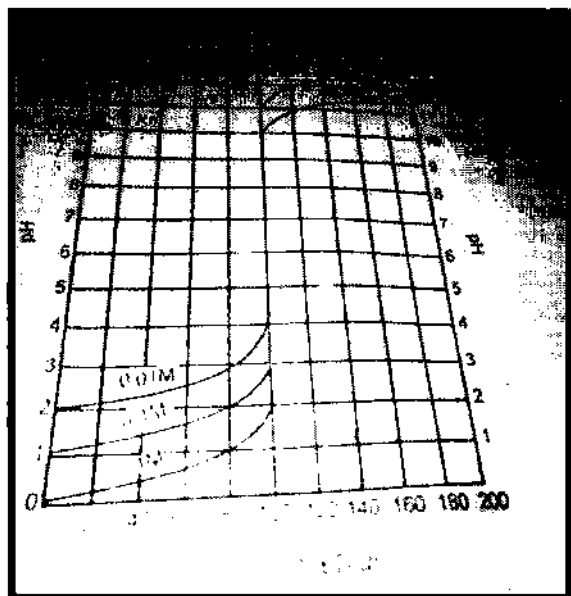
Explain each type with one example.

Q3. A) Discuss titration of strong acid with strong base.

(8M)

Neutralization is combination of  $H^+$  ions of acid with  $OH^-$  ions of a base to form unionized water. Consider titration of  $100\text{cm}^3$  of  $1\text{M}$   $\text{HCl}$  with  $100\text{cm}^3$   $1\text{M}$   $\text{NaOH}$ . Both are completely ionized. pH of  $1\text{M}$   $\text{HCl}$  is zero. When  $50\text{cm}^3$  of  $\text{NaOH}$  is added,  $50\text{cm}^3$  of  $\text{HCl}$  is neutralized and  $50\text{cm}^3$  remains unneutralized in a total volume of  $150\text{cm}^3$ . pH after each addition can be calculated.

When exactly  $100\text{cm}^3$   $\text{NaOH}$  is added acid is just neutralized. Solution contains only  $\text{NaCl}$ . Salt does not hydrolyse. Solution is neutral and pH is 7. beyond equivalence point added base remains unreacted and solution contains excess of  $OH^-$  ions. pH increases steeply.



Q3.B) Explain the fundamental types of gravimetric analysis.

(7M)

- i) Physical gravimetry- involves physical separation and classification of matter in environmental samples based on volatility and particle size.
- ii) Thermogravimetry- sample is heated. With change in temperature, changes in mass of sample are recorded.
- iii) Precipitation gravimetry- involves chemical precipitation of the constituents.

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iv) Electro deposition gravimetry- involves the electro chemical reduction of metal ions at the cathode and simultaneous deposition of the ions.

OR

Q3.C) Discuss the aging or digestion of precipitate with respect to gravimetric technique. (8M)

When precipitation is carried out from concentrated solutions the crystals obtained have imperfect structure and size of primary ppt varies. Crystalline precipitates are easily filterable and purer than colloids. Ease of filtration of coagulated colloids improves if it is allowed to stand for an hour or more in contact with the hot solution from which it is formed. In order to get uniform and larger size, the precipitate is digested. Process is also called aging or Ostwald's ripening.

Digestion helps to give

- i) Particles of uniform size
- ii) Get the precipitate of perfect crystal structure.
- iii) Reduce contamination, increase purity
- iv) Ensure complete precipitation
- v) Bring about coagulation of precipitates.

Q3.D) Explain the role of indicators in acid- base titrations. (7M)

Determination of equivalence point requires the use of an indicator. At equivalence point salt and water are formed and nature of solution depends on nature of salt formed. If acid and base both are strong, pH at equivalence point is 7 and solution is neutral. This is not so if either acid or base are weak electrolytes. The salt formed undergoes hydrolysis and solution at equivalence point is slightly acidic or basic. Large numbers of indicators for acid base titrations are available. Most are organic weak bases or acids which have different color as molecules and as ions. The color exhibited at lower pH is acid color and at higher pH basic color. When both acid and basic colors are present, the color is intermediate or transition color. eg for methyl orange, acid color is red, basic color is yellow intermediate color is orange. (The pH change at neutralization for common indicators like phenolphthalein or methyl orange can be explained)

Q4.a) Discuss in brief application and limitations of Beer – Lambert's law. 8 M

Application:- 4 M

- \*To determine amount of analyte
- \*Understand progress of chemical reaction
- \*To determine strength of solution
- \*Used for measuring concentration and intensity of materials such as:  
Food ingredients, Building materials, Textile products, Beverages
- \*To test for water quality
- \*screening for chemicals such as chlorine, fluoride, cyanide, dissolved oxygen, iron, molybdenum, zinc and hydrazine.
- \*To determine the concentrations of plant nutrients (such as phosphorus, nitrate



and ammonia)

\*Used by the food industry and by manufacturers of paints and textiles.

Limitations :- 4 M

Real deviations-

\*At high concentrations (usually  $>0.01$  M) the extent of solute-solvent interactions. Solute-solute interaction or hydrogen bonding can affect the analyst-environment and its absorptivity.

\*Concentration changes cause significant alterations in the refractive index of a solution, departures from Beer's law are observed.

Chemical deviations-

\*Apparent deviations from Beer's law arise when an analyte dissociate, associate or reacts with a solvent to produce a product with different absorptions spectrum than the analyte.

\*Fluorescence and phosphorescence showing compounds deviate from the law.

Instrumental deviations-

\*Polychromatic and stray radiations affect the absorption because the scattering and reflections off the surfaces of filters.

\*Mismatched cells, cells positioning uncertainties, source flicker noise that is fluctuations in the intensity of a source lead to deviation from the above said law.

b) **Explain principle of column chromatography in brief.**

7 M

In column chromatography, the stationary phase is held in a narrow tube through which the mobile phase is forced under pressure.

Two substances A and B are separated on a packed column by elution. The column consists of narrow bore tubing packed with finely divided inert solid that holds stationary phase on its surface. The mobile phase occupies the open spaces between the particles of the packing. Initially, a solution of the sample containing a mixture of A and B in the mobile phase is introduced at the head of the column as a narrow plug, at time  $t_0$ . Here, the two components distribute themselves between the mobile and the stationary phases. Elution involves washing a species through a column by continuous addition of fresh mobile phase.

With the first introduction of fresh mobile phase, the eluent the portion of the sample contained in the mobile phase - moves down the column, where it further partitions between the mobile phase and the stationary phase partitioning between the fresh mobile phase and the stationary phase takes place simultaneously at the site of the original sample. As fresh mobile phase flows through the column, it carries solute molecules down the column in a continuous series of transfers between the two phases. Because solute movement can occur only in the mobile phase, the average rate at which a solute zone migrates down the column depends on the fraction of time it spends in that phase. This fraction is small for solutes strongly retained by the stationary phase (component B) and large when the solute resides mostly in the mobile phase (component A). Ideally the resulting differences in rates cause the components in a mixture to separate into bands or zones, along the length of the column. Isolation of the separated species is then accomplished by passing a sufficient quantity of mobile phase through the column to cause the individual zones to pass out the end (to be eluted from the column), where they can be detected.

OR

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8 M

c) **Discuss principal & working of paper chromatography.**

Principle:- 4 M

Cellulose fibers in the paper hold moistures (Water molecules) tightly through formation of hydrogen bonds which is stationary phase. The cellulose itself take a negative charge in company of water and solvent system of various solvents are used as mobile phase. Usually stationary phase is more polar than mobile phase. Sample components separation takes place on the basis of partition coefficient. It is also known as distribution coefficient ( $K_D$ ). The distribution coefficient of a solute between two phases is defined as the ratio of the concentration of the solute in one phase to the concentration of the solute in the other phase under the equilibrium conditions.

$$K_D = C_S / C_M$$

where  $C_S$  is the concentration of solute in stationary phase

$C_M$  is the concentration of solute in mobile phase.

Working- 4M

Sample application is done as small and concentrated spot. Generally used device for the application of sample are platinum wire, capillary tube, syringe or micropipette. The spot is generally placed 1.0-2.5 cm from the edge of paper, so that it does not deep into the solvent.

The sample can applied once again at the same spot after complete drying of the first spot. Complete drying can be ensured using air blower.

In all these cases the solvent system is placed at the base of sealed chamber so that it equilibrates the chamber with solvent vapours. Paper chromatography can be carried out in ascending, descending, radial or two dimensional manners.

Once  $3/4^{\text{th}}$  of the paper length run, solvent front is, marked and chromatogram is developed using different detection methods like ninhydrin for amino acids, UV and IR absorption or fluorescence. Rf value is calculated of sample as well as standard for identification of components.

d) **Define filtration and enlist its applications.**

7 M

Filtration:- 4M

Filtration is any of various mechanical, physical or biological operation that separates solids from fluids (liquids/ gases) by adding a medium through which only the fluid can pass. The fluid that passes through is called 'filtrate'. In physical filter, oversized solids in the fluid are retained and in biological filters particles are trapped and ingested and metabolites are retained and removed. However the separation is not complete; solids will be contaminated with some fluid and filtrate will contain fine particles (depending on the pore size, filter thickness and biological activity). Filtration occurs both in nature and in engineered systems, there are biologic, geologic and industrial forms. eg-In animals renal filtration removes wastes from the blood and in water treatment and sewage treatment, undesirable constituents are removed by absorption into a biological film grown on or in the filter medium, as in slow sand filtration.

Methods- Hot filtration, cold filtration, vacuum filtration.

Application-3M

- It is used to separate particles and fluids in a suspension where the fluid can be a liquid or gas or a supercritical matter. Depending on the application either one or both of the components may be isolated.
- Filtration as a physical operation is very imp. in chemistry for the separation of

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the materials of different composition. A solvent is chosen which dissolves one component while not dissolving the other. By dissolving the mixture in the chosen solvent one component will go into the solution and pass through the filter while other will be retained. This is one of the most important. Technique used by chemists to purify the components.

- Filtration is widely used as one of the unit operations of chemical engineering. It may be simultaneously combined with other unit operation to process the feed stream as in the biofilter, which is a combined filter and biological digestion device.
- Filtration differs from sieving where separation occurs at a single perforated layer. In sieving particles that are too big to pass through the holes of the sieve are retained. In Filtration, a multilayer lattice retains those particles that are unable to follow the tortuous channels of the filter. Oversize filter may form a cake layer on the top of the filter and may also block the filter lattice preventing the fluid phase from crossing the filter. Commercially the term filter is applied to membrane where the separation lattice is so thin that the surface becomes the main zone of particle separation even though these products might be described as sieve.

**Q-5** Write a short note on-

a) Geometrical isomerism: Geometrical isomerism is characterised by compounds having the same structure but different spatial arrangement of groups around carbon-carbon double bond & because of molecular symmetry these compounds do not rotate the plane of polarised light.

Give examples of cis & trans isomers of alkene.

b) Diastereoisomers: Stereoisomers of a molecule which are not mirror images of each other are known as distereoisomers.

Distereoisomers must contain more than one chiral centre.

Give any four characteristics of distereoisomers.

c) Advantages of Organic reagents used in Gravimetry-

advantage of organic reagents as precipitants over inorganic reagents

i) The precipitates formed (organometallic compounds) have high molecular weight.

Gives accurate results as percentage error is reduced.

ii) By maintaining proper pH, one metal ion can be precipitated in presence of other ion without interference.

iii) The precipitate can be dried at suitable temperatures and weighed which is less tedious than ignition and weighing required for inorganic precipitation.

iv) Organometallic precipitates are less soluble than inorganic precipitates and thus accuracy of result is more.

v) Particle size is better, better suited for filtration and washing.